58. a

THE PRACTISE of Fortification:

Wherein is ſhewed the manner of *fortifying in all ſorts of ſcituations*, with the conſiderations to be vſed in delining, and making of royal Frontiers, Skonces, and renforcing of ould walled Townes.

Compiled in a moſt eaſie, and compendious method, by Paule Iue. *Gent.*

Imprinted at London by Thomas Orwin, for Thomas Man, and Toby Cooke. 1589.

PRACTISE of Fortification:

WHereinnis shewed the manner of *forty-two* [illegible] *of Fortifications*, with the consideration to be vsed in deliuing, and making of royal [illegible], Sconces, and [illegible] of ould walled Townes.

Compiled in a most easie and [illegible] by Paulo Luc Gesi.

Imprinted at London by [illegible] for Thomas Man, and Toby Cooke, [illegible]

To the Right Honorable Sir William Brooke, of the most noble order of the Garter Knight, Lord Cobham, Lord Warden of the Cinque Ports, and their members, of her Maiesties most honorable priuie Counsaile, and Lord Lieutenant of the Countie of Kent.

And vnto the Right Honorable Sir Frauncis Walsingham Knight, principall Secretarie to her Maiestie, Chancelor of the Dutchie of Lancaster, and of her Highnesse most honorable priuie Counsaile.

THe manifold benefites that I haue receiued at your Honors hands, since my returne into England, haue enforced me to seeke some meanes whereby I might make known my thankfulnes for the same. And finding nothing more agreeable vnto your Honorable cares in the seruice of her Maiestie, wherein I might do you more humble seruice then in the practise of Fortification, hauing had sight therein since the view taken by the Marques Vitell, for the oppressing of the Lowe Countries, with the yoke of Citadels, and exercise sithence Don Johns departing from Bruxels vnto

Nature: which practise, although it be not so common amongst vs, (or of some thought altogether so necessary for vs) as for the nations whose countries do lie adioyning together, where an enemie may enter with a great number of horse & men vpon the sodaine: yet is the knowledge necessarie, that when the practise should bee put in execution in the seruice of her Maiestie, that perfection might be efected that might do her Highnesse seruice. And therfore I haue compiled this little treatise of the practise of Fortification, which I most humbly present vnto your Honors, beseeching you to receiue it as a most humble token of the desire I haue to do you seruice.

Your Honors most humblie readie at commaundement.

Paule Iue.

The Practise of Fortification.

The necessary placing of a Forte.

The 1. Chapter.

THE reason that moued men first to enclose their Cities and other habitations with walles, was, to be assured from enemies, and that a small number might defende themselues from the violence and oppressions of a great, wherein their first practise extended no farther then the preseruation of priuate estates, vntill such time as it was considered, ẏ not only perticuler places, but also the generall estate of a Kingdome, Prouince, or Countrey, might be defended, by placing of walled Townes, Castels, and Fortresses, vpon the edge and borders of the same; of such sufficient strength and greatnesse, as that in time of peace, they might be kept with a fewe men, and vppon a surmize of warre, receiue a greater number, by whome the enemye borderer should not only be anoyed in his Countrey, and hindered to enter vppon the lands of his neighbours so frontiered with any small power vpon the suddaine: but bringing any great army, be constrained not to passe the Fort without subduing it, for auoiding the great mischiefe he might receiue of so noysome an enemy left behinde him, which to inuade, would aske great charge, time, and trauell, besides the danger that might happen. In placing of which Fortresses, two things are chiefely to be considered of, the necessitie, and the scituation: for as a Forte not placed where it were needefull, might skantly be accompted for frontier; so hauing no benefit of

the place it ſtandeth in, it might hardly be reckoned for fortreſſe, ſo that the one muſt helpe the other to the beſt effect that may be.

A Fort therefore that ſhall ſerue for a frontier, muſt bée ſet néere the walled Townes, Caſtels, and frontiers of the enemy borderer, or néere other places where an enemy may make any ſudvaine aſſembly of people in hys Countrey: hauing the way from thence commodious to enter vppon the lands of his neighbours, and the retreate good, and vppon the Seacoaſts at Hauens and Roades, where a Fléete of Ships may be harboured, and haue commodious landing: in which places, becauſe the grounds may be of diuers natures for this purpoſe, I will ſhewe the manner of fortifieng in all ſorts of grounds, and the commodities and diſcommodities that a fort may haue of the place where it ſtandeth in.

The manner of fortifying in all ſorts of grounds, and the commodities and diſcommodities a Fort may haue of it ſcituation.

The 2. Chapter.

WHo ſo ſhall fortifie in playne ground, may make the Fort he pretendeth of what forme or figure he will, and therefore he may with leſſe compaſſe of wall encloſe a more ſuperficies of ground, then where that ſcope may not be had. Alſo it may be the perfecter, becauſe the angles that do happen in it, may be made the flatter or sharper. Moreouer the ground in plaines is good to make ramperts of, and eaſie for cariage, but where water water wanteth, the building is coſtly and chargeable, for that a Fort ſcituated in a dry playne, muſt haue déepe ditches, high walles, great bulwarks, large ramparts, and caualieros: beſides, it muſt be great to lodge fiue or ſixe thouſand men, and haue great place in it for them to fight, ranked in battaile. It muſt alſo haue countermines, priuie vitches, ſecret iſſuings out to defende the ditch, caſmats in the ditch,

couered

couered wayes round about it, and an argine or banke to empeache the approach, will require great garrison, much artillerie, powder, victuals, and other things necessarie for the keeping and mainteining of it, is subiect to mynes and to caualieros, may be surprised, scaled, battered, and assaulted on euery side, and may be kept besieged with forts, men, hoste, and artillerie.

Where water may be found, the fort may be the lesse, and needeth not the ditches so deepe as in dry ground, for it will be free from surprise, scale, and myning, and being battered the assault will be troublesome, for that one man standing vppon firme ground, may resist fiue vpon a bridge, boat, floate, or such like. Moreouer, the fort standing neere vnto any riuer, may receiue great commodities of it for the bringing of things necessarie vnto it, both for making and mainteining of it, and it may haue the riuer turned into the ditch to scowre the ditch of any thing that may be cast into it, and the same may also be kept vp with sluses within the fort to drowne the ground about it, and in those lowe places which abound with water, an enemy can hardly couer himselfe from the fort.

Betwixt these two scituations, there are diuers opinions held, some commending dry ditches, alleadging that by a dry ditch a fort may receiue reliefe, the ruine that a batterie maketh may be taken away, and any thing that an enemy may cast into ỹ ditch to fill it, may be burnt, & by the sallies that may be made out of a dry ditch, an enemy may be charged in his trenches on euery part, (which may serue the turne for a while) but these consider not the counterscarpe being wonne, the benefit and vse of the ditch will be taken away by the artillerie and harquebusserie of the enemy: nor that of those three meanes wherewith a wall may be breached, to wit, the Cannon, myne, and mens hands, water hindereth the putting in practise of two of them. The discommodities that proceede of water, are these, in hoate Countreys standing water engendreth infectiue ayres, and in colde Countreys it freeseth that men, hoste, and artillerie may passe ouer.

In fortifying amongst hilles, make choise of those that are like piramides, or that haue no ground of equall height, with the superficies of their tops, more then the fort and the ditch will occupy, to the intent that from the Fort an enemy may be impeached the assent of the hill. For which consideration, the fortifier shall be oftentimes constrained to make the Fort greater then it were needfull it should be, and ofttimes with great circuit of wall shall enclose but a small superficies of ground; but being so placed, it needeth no great place in it, nor royall defences, as great Bulwarks, Flanks, or Ramparts, because it will not be subiect vnto batterie, but will be assured through the valley and hanging of the hill, which will giue an enemy trouble in lodging, trenching, taking away the defences, batterie, and assault, and being myned, the effect might happen to little profit, for the inequalitie of the ground. Besides, if the defenders should charge their besiegers, the one quarter of the Campe could not succour, or be succoured of the other. Or if the defenders should be enforced to retire, they might do it with aduantage ynough, hauing most commonly a higher ground to repaire vnto, but when that choise may not be had, but that the superficies of the hill top be more then the Fort may occupy, then must he chose the higher part of the hill, placing the Fort, that so great part of it may enioy the benefit of the hanging of the hill as possible may, and towarde the other part of the same, build as in a dry playne, for as part in respecte of the valley vnder it may enioy the benefite of the hilly scituation, so part in respect of the equalitie of the ground without it, vppon which an enemy may lodge, trenche, myne, batter, and assault (especially if the grounde may be broken with Spade, Pickaxe, and such like) is subiect to all those discommodities that a Fort scituated in a dry plaine.

A Fort scituated among Mountaines, can hardly be kept besieged with forces, men, horse, and artillerie: but those fortes that are scituated vpon hills and mountaines are troublesome to make for the difficultie of bringing of stuffe to the place, are subiect to surprize, suffer oft times great penurie of water, and oft times are troubled with great raynes, which seeking

ſſlue, do cauſe ruyne of their walles.

A Fort ſcituated in a lake, néedeth no great defences: as great bulwarks, ramparts, cauallieros, nor large flanks, becauſe it is free from batterie and aſſault, but through the euill aire of the lake, it will oft times be beſieged of it ſelfe. Beſides, an enemy may eaſily beſiege it, in placing Forts where it hath recourſe to the land, and proceéde on hys voyage, aſſuring himſelfe that the Fort muſt come into his hands, for as it is hard to be aboyded; ſo it is to receiue ſuccour, and able to do an enemy but little hurt.

Of Forts placed vppon ſmall riuers, is ſufficiently ſpoken before, and thoſe that ſtand vpon great riuers, may partly be compared with thoſe in lakes, but where they may be approched, their defences muſt be great, are free of the infectiue aire which the lake oft times yéeldeth, may better receiue ſuccour, and giue an enemy great trauell in the aſſiege.

A Fort ſcituated in the Sea, is not only free from batterie and aſſault, becauſe the batterie that may be made at Sea is feeble, weake, and vncertayne, by reaſon of the Seas continuall motion; but alſo is free from beſieging, not only for that thoſe enemyes are fewe that can put any great armye to Sea: but alſo becauſe the Winde and Seas alteration is ſuch, that an Aſſige at Sea cannot be continued. Moreouer, it may be mainteined with Merchant trade, and with it Shipping occuppe thyngs apperteyning to other men. But a Fort that ſtandeth in the Sea cannot ſerue the land it ſtandeth neere vnto for frontier, but at Sea only, becauſe it may not put men and horſſe a ſhoare, and ſerue them for retreate.

A Fort that muſt ſerue for frontier vppon the Sea coaſt at hauens, roades, and ſuch like landing places, muſt be ſet part within the Sea, or at leaſt ſo neere vnto the Sea, that an enemy may make no Fort, Trench, or other couerture, how little ſo euer it be, to ſaue himſelfe from the violence of the Fort betwixt the Sea and it, nor may vſe any artillerie within one or two hundred paces on neither ſide of the porte, or hauen, to impeache ỹ free entring and going out of Ships, and being ſo placed for the benefit it hath of the Sea, it may

be the greater, and both in time of warre and peace be kepte and defended with lesse number of men and prouision: because it may be succoured at all times, and may serue it selfe with the commodities both of Sea and Land, and may serue for frontier vnto both, for that it may kéepe shipping, men, and horsse. And to besiege a Fort so placed, an enemy that dwelleth vppon the same mayne the Fort standeth, shall be enforced to haue two armyes, the one by Sea, and the other by Lande, and comming from any other part, shall be constrayned to bring in so great an armye by Sea, as that may carry men, horsse, artillerie, and other things, for the mainteyning of the armye, to put ashore, and yet must kéepe the Seas also, but how hard a matter it is to lande an armye, and troublesome to continue an assiege at Sea, and of what valewe those Townes are that haue this scituation, Flushing, Rochell, and Ostende, do, and will beare witnesse, but the discommoditie that those Forts haue that stand by the Sea side where great ebbes do runne, is, they are subiect vnto surprize at lowe water.

The manner of the lyning out of a Fort, and the considerations to be vsed therein.

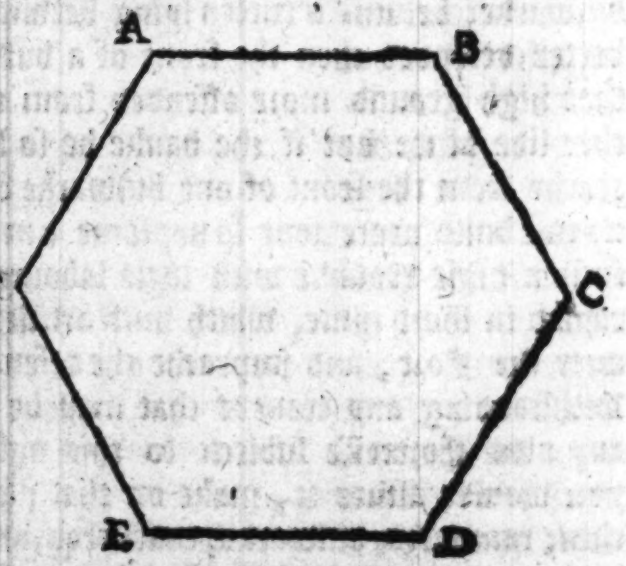
The 3. Chapter.

IN the delineation of a Fort that shall serue for a royall frontier, the figure triangular is not to be vsed at all, nor the quadrant, but only in those watrie grounds where it can not be approched, neither is the cynqueangle to be chosen for any perfection that is in ỹ figure, for this purpose (although that many good Forts are made in that forme of the Castell of Antwerpe, the citadell of Turyne and others) but rather for sparing of charges

ges in building & mainteing the Fort, for the exteriour angles of the bulwarks placed vpon the angles of those figures, do fall out sharpe, and therefore are weake to resist a batterie, and hard to be defended, but in other figures they become flatter, and the more bulwarks a Fort hath, from the more places it may trauell and offende an enemy; but then it will require the greater garrison, prouision, and artillerie, the more cost in making, and care in keeping. All which being considered, lyne out the Fort you pretend, if nothing do hinder the deliniation, nor that any part may be lesse approchable then other with equall sides and angles; but if any part may be better assured of the situation then the rest, on that side lay out the longer sides and sharper angles, or both, to the intent the other part more easie to be approched, may be the more defenceable: yet herein there must be a foresight, that the Fort may fall out as circular as possible it may, and being constrayned to fortifie neere any banke, or high ground, place a curten against it, and not a bulwarke, because a curten lying betwixt two flanks may be better defended then the front of a bulwarke from one, and that high ground more offended from the bulwarks on either side of it: but if the banke be so large that it woulde reache from the front of one bulwarke vnto another, then in no case build neere none so noysome a neighbour, for vppon such a high grounde with little labour may be cauelieros raysed in short tyme, which with artillerie may commaunde ouer the Fort, and impeache the defence of a breache, notwithstanding any trauers that may be made, and finding any olde Fortresse subiecte to this mischiefe from whiche you woulde assure it, make on that parte the walles, ditches, ramparts, bulwarks, cauelieros, and parapetes, deeper, higher, and larger, then of custome, laying the superficies of the rampart hanging somewhat inwarde. The Citie of Gaunt being subiect to such a high ground that lay hard vnto the ditch side thereof, by the aduise of the foresight, the Prince of Orange fell to worke, with spade, pickare, horse, cart, & willing people, and in short time rebated the prive of it, caryng away parte into a valley, and bringing parte into the Citie, making

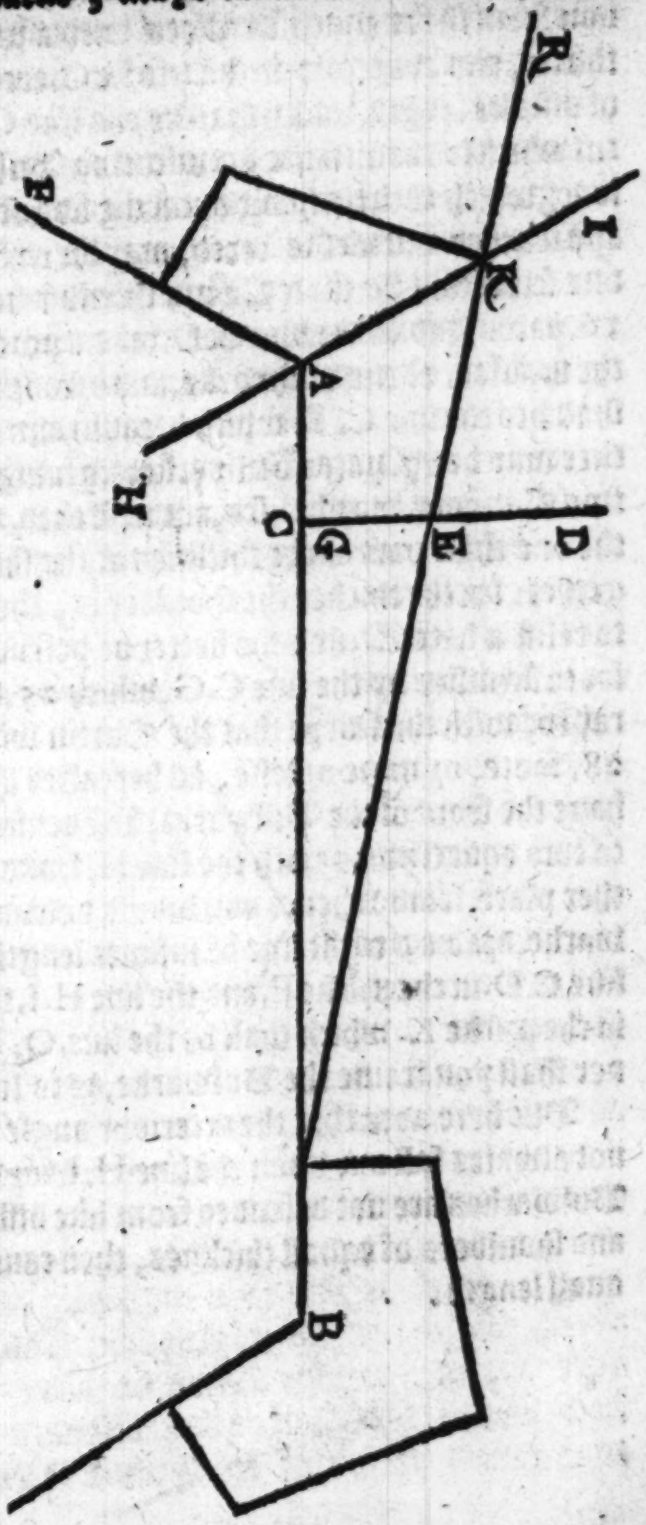
of it bulwarks, ramparts, cauelieros, parapets, and the reſt, ſo ỳ that ground which firſt commaunded the Citie, was afterward made ſubiect, the Citie commaunding it: but theſe like labors may be practiſed where neceſſitie enforceth, but not where frée choiſe may be vſed for auoiding of ſuperfluous charges, time, trauell, and anoyance.

But to returne to the practiſe of the deliniation, being vppon the ground to be fortified, take good viewe where it were neceſſarie the bulwarks which are the chiefeſt and royaleſt defences ſhould be placed, (which muſt be where they may domayne and commaund ouer the ancomings to the Fort, be as hard to be approched, and as little ſubiect to batterie or other offence, as the place wyll permit.) And where you determine to place a Bulwarke, there ſet downe a ſtake, and ſtretch a lyne betwixt ſtake and ſtake, and with a Spade make a little cut alongſt the lyne, as is ſéene in the figure where theſe letters A. B. C. D. E. F. do repreſent the ſtakes, and the lynes the breaking of ỳ grou̅d. Well vnderſtood, that theſe ſtakes tearmed ỳ angles of the meeting of two curtins, or ỳ interior angles of the Bulwarks may not ſtand farther diſtant then 200. pates, or 1000. foote, at fiue foote euery pace, and the reaſon hereof is, that the exterior angle of the Bulwarks placed vppon theſe angles, woulde ſtande too farre from the flanckes, from whiche they ſhoulde bee defended, neyther is there anye greate reaſon to ſet them ſo farre aſunder, for the greateſt



greateſt force of the Cannon, is within an hundred paces, but in conſideration that the rampart which an enemie approaching the front of a Bulwarke, maye make to defende himſelfe from the Artillarie in the flancke, may bee but lose earth, & therefore the leſſe able to reſiſt a shot, it may bee placed the further off.

The circuit of the fort being laide out to faſhion out the Bulwarks proportionall & defenſiue to the ſame, take the one angle of the figure before going, which ſhall bee the angle F. A. B. imagining it to bee placed in a dry plaine, and frame vppon it one Bulwarke, in which all the defences neceſſarie vnto a Forte maye bee ſhewed, which you ſhall doe in this maner. Firſt vpon the line A. B. take 165. foote, or 33. paces (at 5. foot euery pace) for the length of the Bulwarke, which is the line A. C. whiche length muſt bee ta-

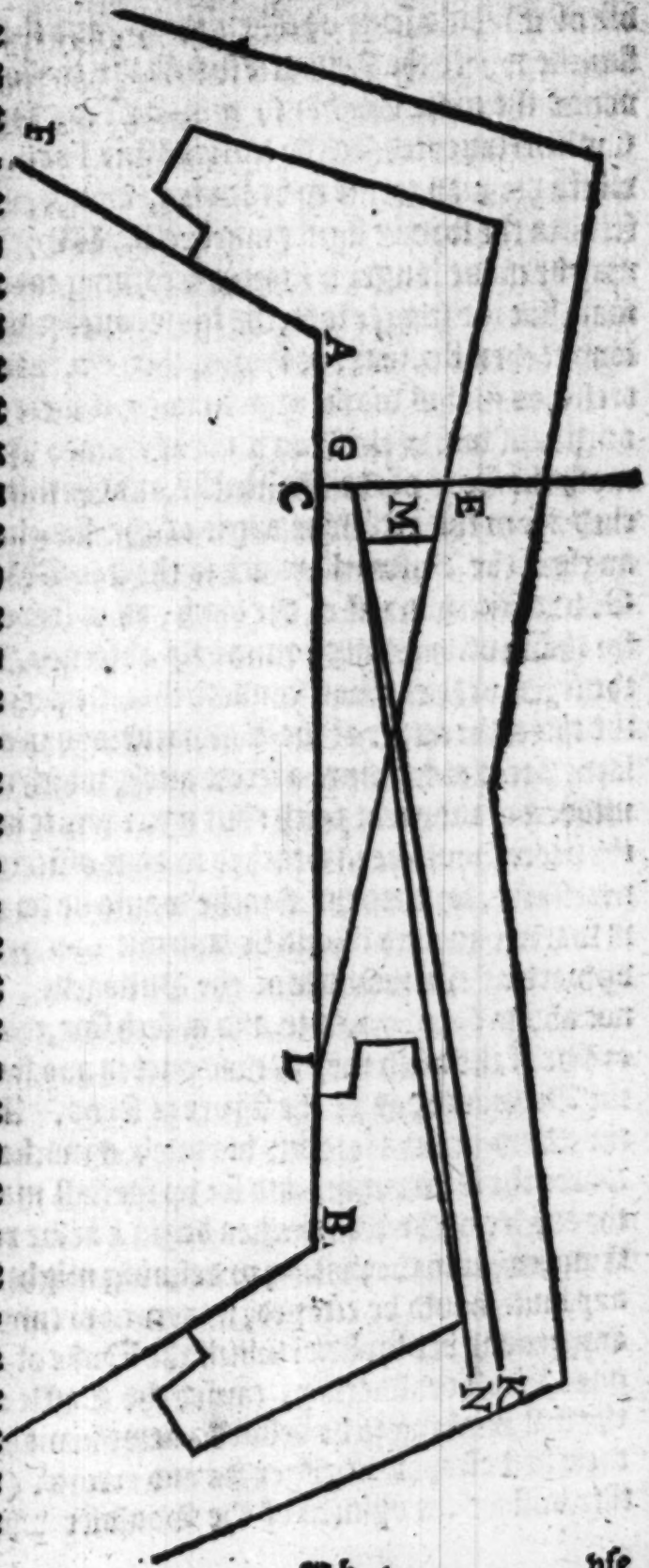


ken with this consideration, that vnto euery place in the flancke where you pretend to vse Artillerie, you must giue 50. foote at the least for the recoyle of a Cannon, and defend the same Cannon from the enemies Artillerie with a parapet of 25. or 30. foot thicke, and therefore at the pricke C. erect a perpendicular line of infinite length, which shall be the line C.D. (so shall the Curtin which is the distance betwixt two Bulwarkes be 134. paces long, which Curtin lying vpon the side of a towne difficill to bee approached and wel watered, may be 12. paces longer; but in a drie scituation the sayd Curtin should neuer be so long by 12. or 16. paces) and of the line C.D. take a portion for the thicknes of the shoulder of the Bulwarke, and breadth of the flancke, which shall bee the line C. E. which breadth and thicknes of both together may be 27. paces or 135. foote, giuing vnto a flancke, where two Cannons may be vsed, not lesse then 25. foot, nor more then the one third part of the thicknes of the shoulder and flancke together: for the thicker the shoulder is, the longer it shall be able to resist a batterie, and the better be defended: wherefore take 25. foote signified by the line C.G. which 25. foote (the flanke being raised, with the scarpe that the Curtin will make may bee some 28. foote, or more or lesse, as hereafter shalbe shewed.) And to haue the front of the Bulwarke, first deuide the angle F.A.B. into two equall parts with the line H.I. and from the flancke or other place, from whence you would defend the front of the Bulwarke, drawe a right line of infinite length, which must cut the line C.D. in the pricke E. and the line H.I. where it happeneth, as in the pricke K. which shall be the line Q. R. and after this manner shall you frame the Bulwarke, as is seene in the figure.

But here note that the exteriour angle of the Bulwarke will not alwaies fall out vpon the line H.I. for when the fronts of the Bulwarkes are not defended from like distances and the flancks and shoulders of equall thicknes, then cannot the fronts be of equall length.

More.

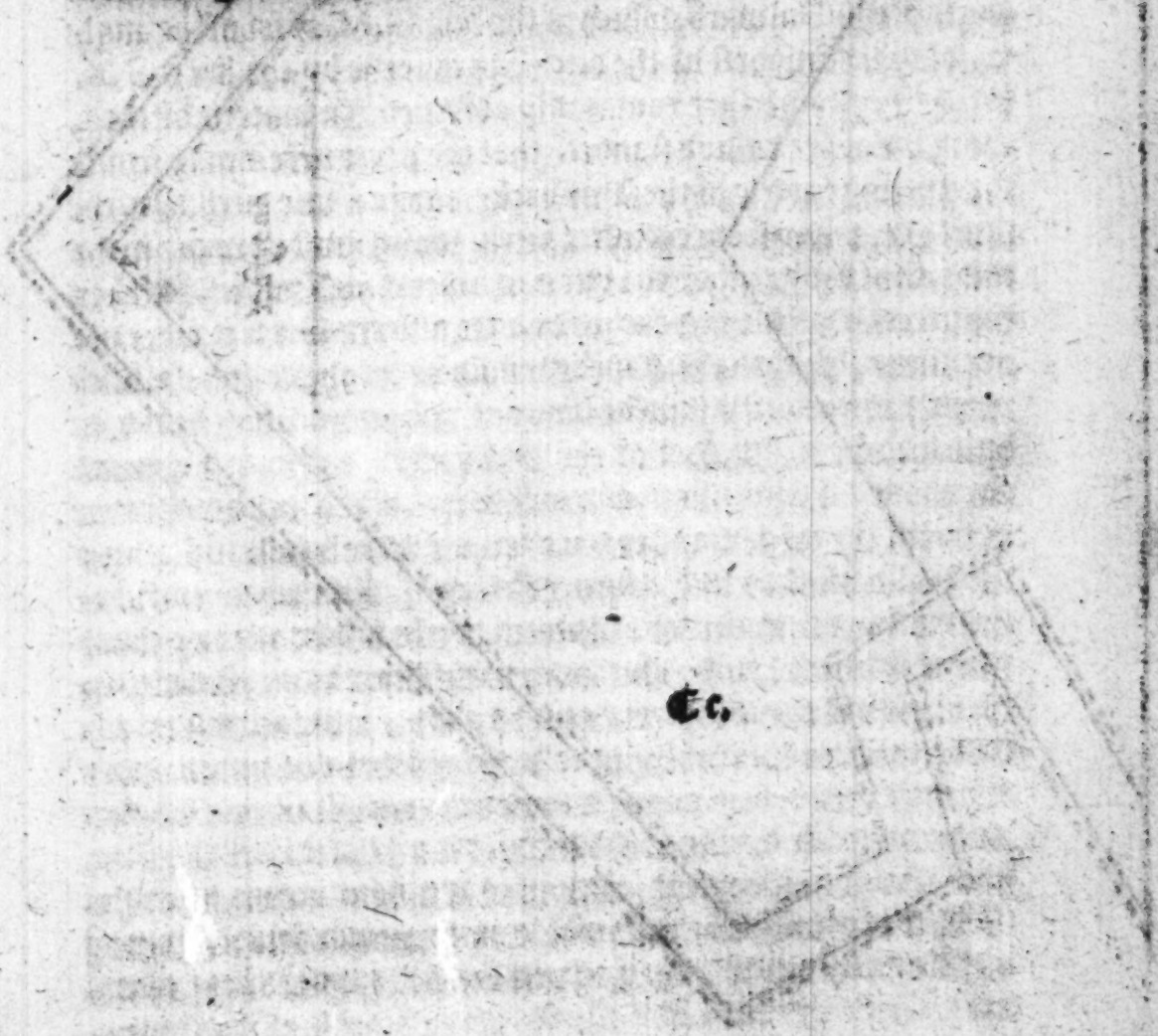
Moreouer, note that the custome is to line out the front of a Bulwark precisely frō the angle of the flanck which doth defend it, but for that precisenes there is no great reason: for the front of such a Bulwark being battered, an enemie may assure himself in ẏ breach from the Artillerie in the flancke, and therefore to enforce him to make ẏ deeper breach, and the better to defend the fronte of the Bulwarke, it were better to line it frō the pricke L, somewhat distant from the flancke: but not so farre distāt but that the artillerie which shoulde scoure the front of ẏ one Bulwarke might lye couered in the other Bulwarke: for if the Artillerie should lie open that it might bee beaten in face and side, the



vse of it would sone be taken away, and the better to couer the flancke where the Artilerie should lye, to the intent to giue an enemie the more trouble to dismount it, was an Orechion or Cullion inuented (as the Italians and Frenchmen do terme it) which we may terme to bee eares, wings, or finnes, such as is seene in the former figure marked M. Which cullion or orechion may be made longer & shorter according to the will of the workman, but the longer it is, the more couered wil the flanck be: but longer then 80. foote, or shorter then 60. foote in so royall a Fortresse, as in this worke is pretended, it were not necessarie. The outside of which orechion must be framed vpon the line that formeth the front of the Bulwarke, and the inside vpon a line stretched from the exteriour angle of the flancke vnto the exteriour angle of the Bulwark, which is the line G.M. or from the angle G. vnto the middest of the ditch, as is seene by the lines G.K. for these customes are commonly obserued. In waterie ditches, the inside of the cullion standeth that the peece next it may scoure the exteriour angle of the Bulwarke: and in a drie ditch, that the same peece may scoure a secret ditch, which must be made in the middest of the great ditch: but narrower it may not be, for then the peece should be impeached to do it office: & wider it were not necessarie, for then the flancke would be too open: and the ditch in waterie ground would be layd out 100. or 120. foote broad, or vpward at the shoulder of the Bulwarke, and in drie ground not aboue 60. or 70. foote, and in such sort, that the counterscarpe or side of the ditch may bee vncouered and lye wholly open vnto the Bulwarke, as in the figure is seene. And when you haue thus lined out the fort and his ditch, & marked vpon the ground where the lines runne, and set vp speciall markes or stakes, for the angles of the Bulwarkes begin a newe reuiew, to see if any thing, either in the placing or delining might be amended. For if any fault should be escaped, it were now time to amend it before any ground bee broken: which the Duke of Alua and the Marques Vitell considering, caused the Castle of Antwerpe after the first marking to be delined a newe in many parts, correcting their first escaped negligences and errors. (Here note, that in this busines the opinion of the Souldier who hath had experi-

ence

gnce of the defence, and offence, is to be preferred before the opi-
nion of the Geometrician, or Maſon, who are inexpert, of the
practiſes that an enemie may put in execution) To preſerve, lay
out the breadth that the thickneſs of the wall and the Eſperons or
Counterforts ſhall occupie in the front of the Bulwarke, and
likewiſe that in the Curtin: which breadth in the one may be 32.
foote, and in the other 18. foote: the reaſon thereof is hereafter
ſufficiently ſhewen, and likewiſe drawe a line two foote eque-
diſtant vnto the front of the Bulwarke and Curtin both out-
wardly and inwardly for the foundation ſignified by the pricks,
which foundation muſt bee ſo much broader then the wall, and
the Counterforts that ſhall bee raiſed vppon it, as in the figure
following is ſeene.



&c.

100 feet

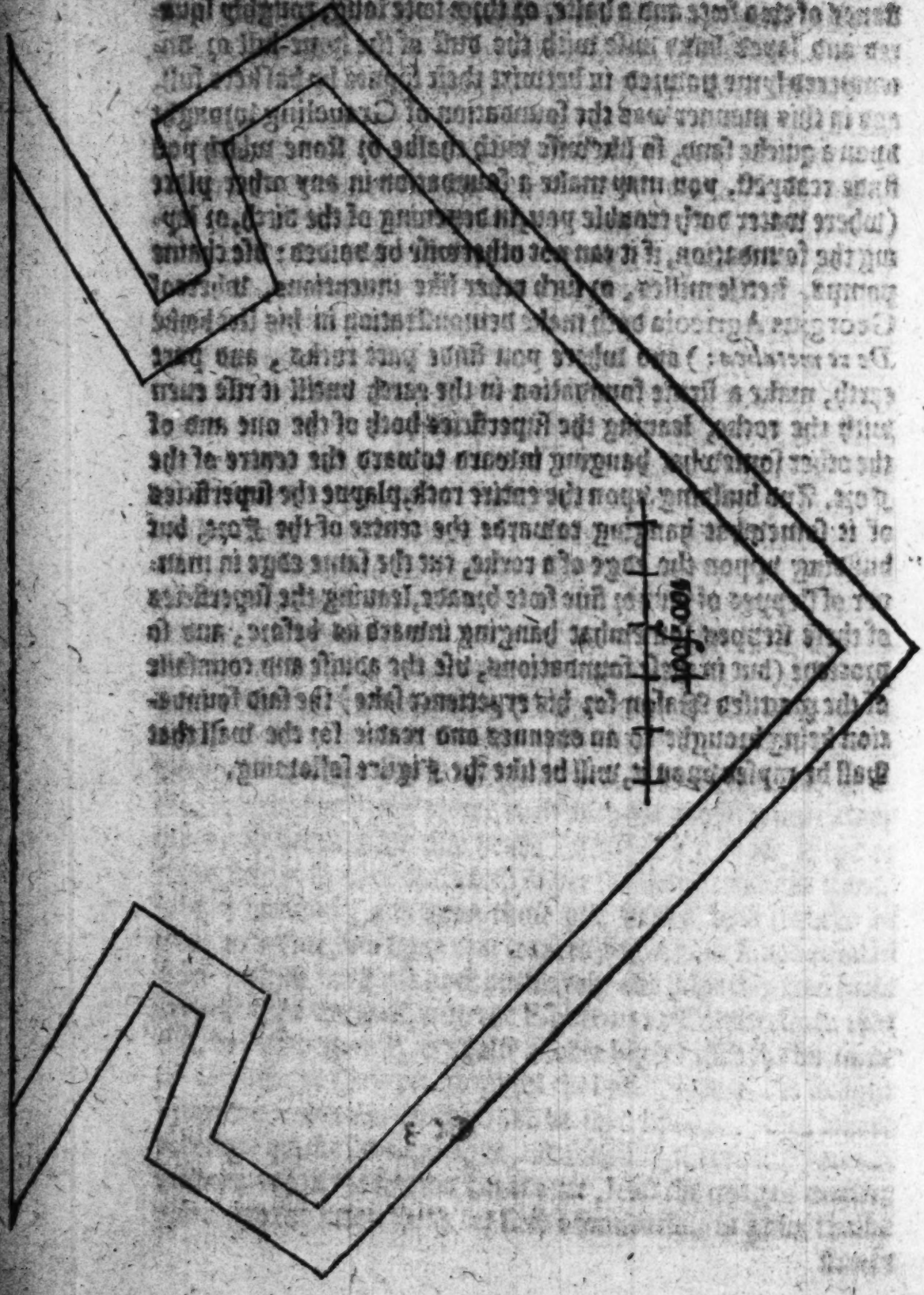
The foundation, ditch, secrete ditch, and countermine.

HAuing layd out the superfices that the Fort will occupie, begin to breake ground, bringing the earth inward into the Fort, to rampier withal, forseeing as much as may bee to auoyd the superfluous charges of oft remoouing it, and when you haue digged seauen or eight foote deeper then you pretend to make the ditch (or more or lesse according to the goodnes of the ground, lay the superficies of that bottome somewhat hanging inward toward the center of the Fort, and worke your foundation, as hereafter shalbe shewed) the depth of which ditch in drie ground may bee 30. or 40. foote, and more, according to the cost that will bee bestowed, besides the depth of the secrete ditch which may be made in the great ditch to ease the charge of the building, which also may be 20. foote broade, and 10. or 12. foote deepe: for the chiefest strength in a Fort that standeth drie is the depth of the ditch; for the deeper the ditch is, the more trouble it giueth an enemie in cutting the Counterscarpe, and in myning the better it will receiue the ruine of a breach, and maketh the assault more difficill: but where water aboundeth, that depth cannot be had, neither were it altogether necessarie, but there 10. or 12. foote vnder the superficies of the water, or more or lesse as the water will permit, is to bee thought a great depth, but then it must bee the broader, as 100. or 120. foote, as is before shewed, where the other neede not be aboue 60. or 70. foote: and the reason of this breadth in the one is, that an enemie may bee the more troubled to abourd the Fort: and of that narrownes in the other, that he may bee the more offended in the approaching and cutting the Counterscarpe, and that the defenders may be the more couered in the ditch. But when by this ditch and secrete ditch a Fort cannot bee assured from the mine, which an enemie may put in practise, then must a countermine be made, which countermine of some hath bien made to little effect vpon the foundation within the Fort. But of others with-

out in the ditch hard against the foundation to better purpose, but that it weakeneth the foote of the wall: wherefore to auoyd that daunger, make the countermine 25. or 30. foot distant from the wall, and so deepe in the ground, as an enemie may go with a mine. Which countermine must be 4. foote broad, and 6. or 7. foote high, and must haue vents made in the top of it, whereby it may receiue light: and the best way into it, were some 40. foote distant from the Bulwarke Orechion or Cullion, as shall bee shewed hereafter, that it may be vsed not troubling or impeaching the Bulwark, nor impeached by it: but in the worke it must bee the last thing performed, when the ditch is emptied. But for the foundation of a Fort, if the same be to be made in a fenne, marish, or other such like grounds, which of themselues are not able to beare the waight of the wall and rampier that shall be raised vpon them, lay a trauers of trees in the bottome of the foundation of Okes, or other wood, which will longest continue good in the earth, laying them thwart wise in the work the one fast and close shut to the other, and hanging somewhat inward toward the center of the Fort. And where this foundation is not thought to be sufficient, there driue in piles, the one halfe a foote distant from the other, or more or lesse as shall bee needfull, first driuing in one pile as farre as it may go, and by the deapth of that one pile in the ground fit the length of all the other, which piles being driuen euen with the ground, pare away the earth betwixt the pile heads some halfe a foote deepe or more, and in stead of that earth so pared away ramme in stones with a rammer, and vpon those pile heads lay a trauers of trees, as before, and vpon that trauers, begin your foundation of stone, which must rise both outwardly and inwardly two foote broader then the wall, with the Esperons or Counterforts that shall be raised vpon it, and halfe a foote higher then the bottome of the ditch, to the intent it might the better support the waight of the wall and rampier that shall be layd vpon it. But where you finde quicke sands, quages, and such like, there must you not worke much of the foundation at once, least the quages maister you: and the fittest stuffe for such a foundation is great thicke

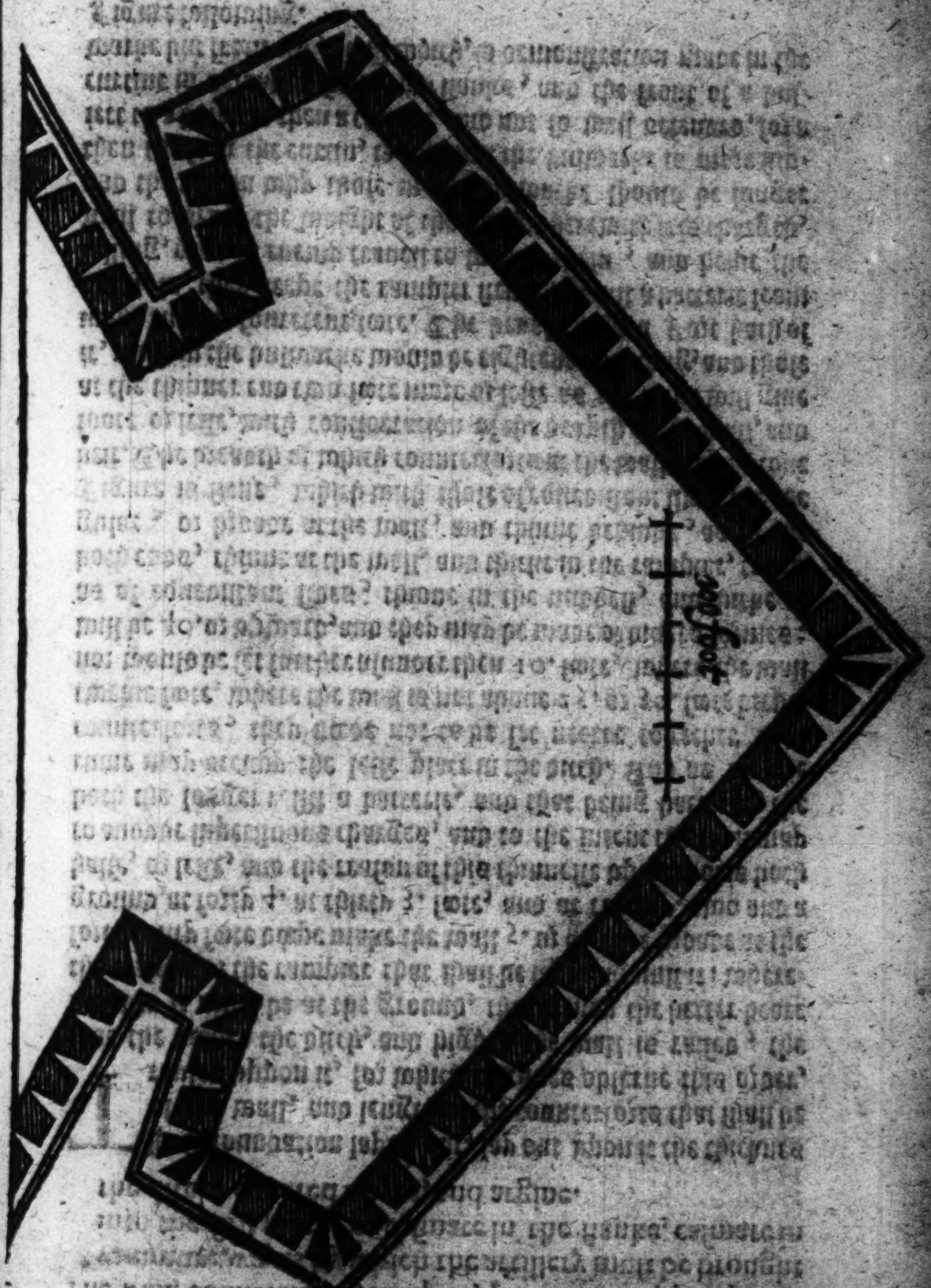
stones

stones of two foote and a halfe, or three foote long, roughly squared and layed bond wise with the dust of the lyme-kill or vntempered lyme powred in betweene their ioynts by baskets full, and in this manner was the foundation of Graueling wrought vpon a quicke sand, so likewise with chalke or stone which you finde readyest, you may make a foundation in any other place (where water doth trouble you, in depening of the ditch, or laying the foundation, if it can not otherwise be voided: vse chaine pomps, kettle milles, or such other like inuentions, whereof Georgius Agricola doth make demonstration in his first booke *De re metalica:*) and where you finde part rocks, and part earth, make a firme foundation in the earth vntill it rise euen with the rocke, leauing the superficies both of the one and of the other somewhat hanging inward toward the centre of the Foyt. And building vpon the entire rock, playne the superficies of it somewhat hanging towarde the centre of the Foyt, but building vppon the edge of a rocke, cut the same edge in manner of steppes of four or fiue foote broade, leauing the superficies of these steppes somewhat hanging inward as before, and so proceede (but in these foundations, vse the aduise and counsaile of the practised Mason for his experience sake) the said foundation being brought to an euennes and readie for the wall that shall be rayled vppon it, will be like the Figure following.

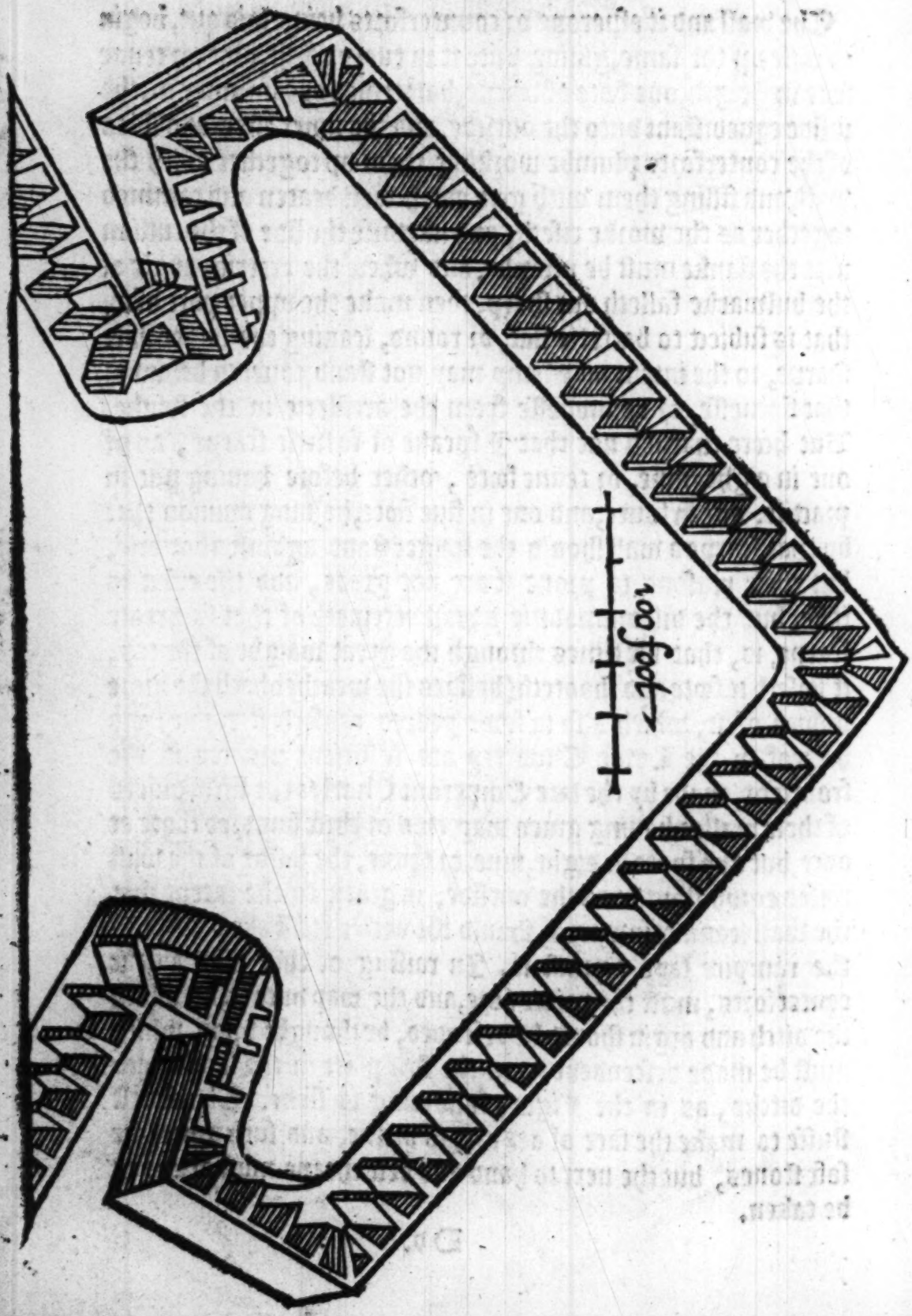

100 foot

The wall, counterforts, rampier, priuie dores, parapet or vammure, wayes by which the artillery muſt be brought into the firſt place, or caſmate in the flanke, caſmate in the ditch, couered wayes, and argine.

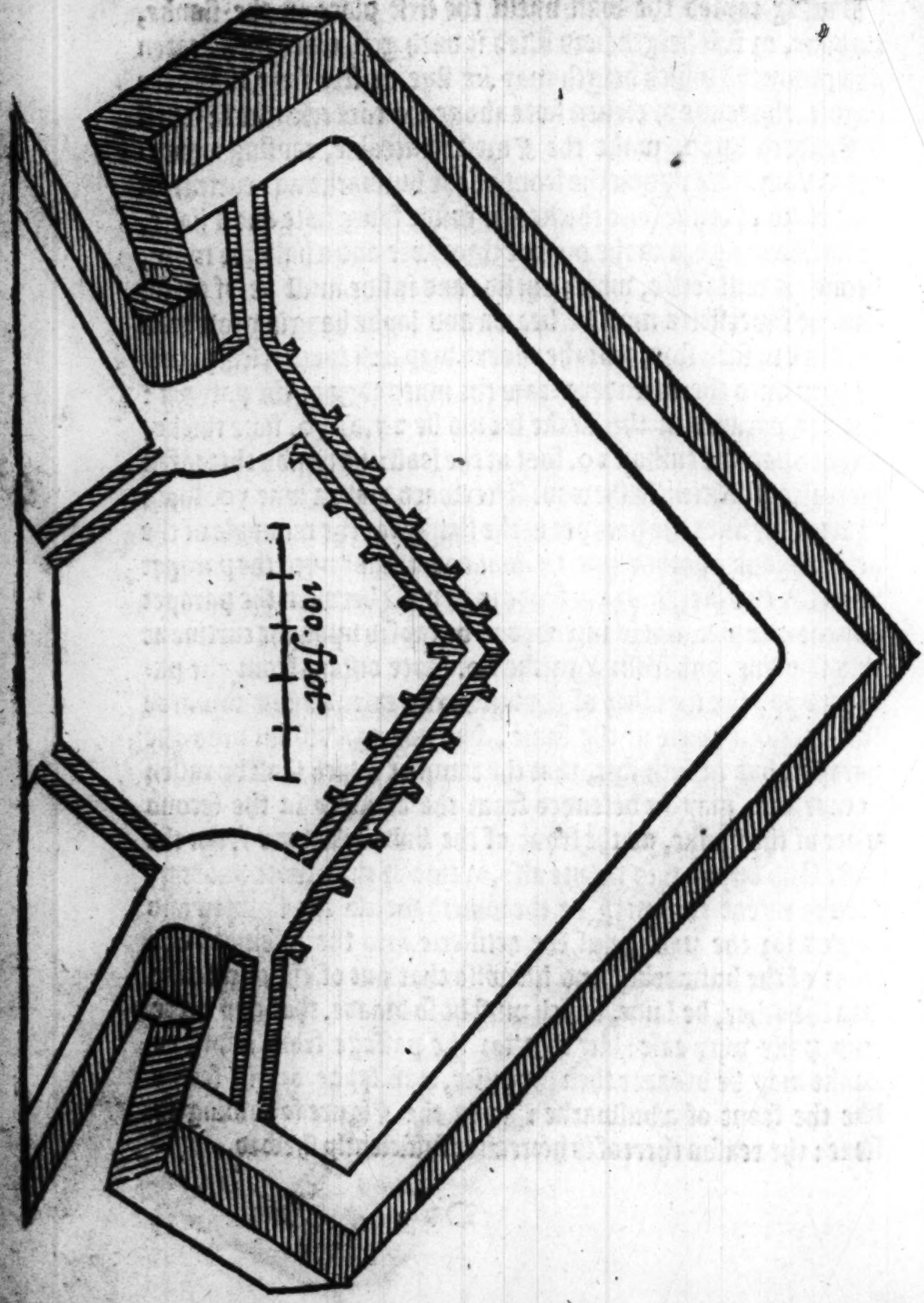
THe foundation layde out, lay out vpon it the thicknes of the wall, and length of the counterfoyts that ſhall be raiſed vppon it, for which thicknes obſerue this order, that the deeper the ditch, and higher the wall is raiſed, the broader it muſt be at the ground, that it may the better beare the waight of the rampier that ſhall be layde againſt it: wherefore at fifty foote deepe make the wall 5. or 6. foote broade at the ground, at forty 4. at thirty 3. foote, and at twenty, two and a halfe, or leſſe, and the reaſon of this thinneſſe vpwards, is both to auoyde ſuperfluous charges, and to the intent the wall may both the longer reſiſt a batterie, and that being battered, the ruine may occupy the leſſe place in the ditch. And as for the counterfoyts, they néede not to be ſet neerer together then twelue foote, where the wall is not aboue 25. or 30. foote déepe, nor would be ſet further aſunder then 10. foote, where the wall will be 40. or vpward, and they may be made of diuers formes: as of equediſtant ſides, thinne in the middeſt, and thicke at both ends, thinne at the wall, and thicke in the rampier, triangular, or broade at the wall, and thinne behinde, as in the Figure is ſéene, which with thoſe of equediſtant lines are the beſt. The breadth of which counterfoyts at the wall may be four foote or leſſe, with conſideration of the deapth of the wall, and at the thinner end two foote more or leſſe as the ſtuffe will giue it, thoſe in the bulwarke would be eighteene foote long, and thoſe in the curtine fouretene foote. The benefit that a Fort hath of them, is, they keepe the rampier firme againſt a batterie from falling, giue an enemy trauell to breake them, and helpe the wall to beare the waight of the earth wherewith it is charged, and the reaſon why thoſe in the bulwarke ſhould be longer then thoſe in the curtin, is, becauſe the bulwarke is more ſubiect to a batterie then a curtine, and not ſo well defended, for a curtine is defended from two flanks, and the front of a bulwarke but from one, of all which, is demonſtration made in the Figure following.



The wall and it esperons or counterforts being laid out, begin to raise vp the same, giuing vnto it in euery eight, nine, or tenne foote in heigth, one foote of scarpe, battering, or comming in, the inside equedistant vnto the outside, and the inner ends and sides of the conterforts plumbe working them vp together with the wall, and filling them with good earth well beaten and rammed together as the worke riseth, and likewise the side of the cullion next the flanke must be plumbe, and when the exterior angle of the bulwarke falleth out sharp, then make the vpper part of it, that is subiect to batterie flat, or round, leauing the vnder part sharpe, to the intent an enemy may not stand, couered behinde, that flatnesse, or roundnesse from the artillerie in the flanke. But heere maruell not that I speake of so little scarpe, as of one in eight, nine, or tenne foote, other before hauing put in practise, one in foure, and one in fiue foote, holding opinion that by that scarpe a wall should the longer stand against a batterie, but their reasons to proue it are not great, and the effect is lesse, but the discommoditie a wall receiueth of that so greate scarpe, is, that oft times through the great waight of the top, it loseth it foote and shooteth (besides the weather hath the more power of it, which also in fewe yeares causeth it rupne) and hereof in the Lowe Countrey are sufficient proofes in the frontiers, made by the late Emperour Charles the fifth, diuers of their walles hauing giuen way two or three hundred foote at once, but one foote in eight, nine, or tenne, the inside of the wall raised equidistant vnto the outside, is giuen to the intent that the wall leaning inwards, should the better resist the waight of the rampire layd against it. In raising of this wall and it conterforts, must the priuie bore, and the way vnto it, by which the ditch and argin should be defended, be thought vpon, which must be made descendent from the first place in the flanke into the ditche, as in the Figure following is seene. The fittest stuffe to make the face of a Fort, is bricke, and such other like soft stones, but the next to hand and best cheape must alwayes be taken.


100 foot

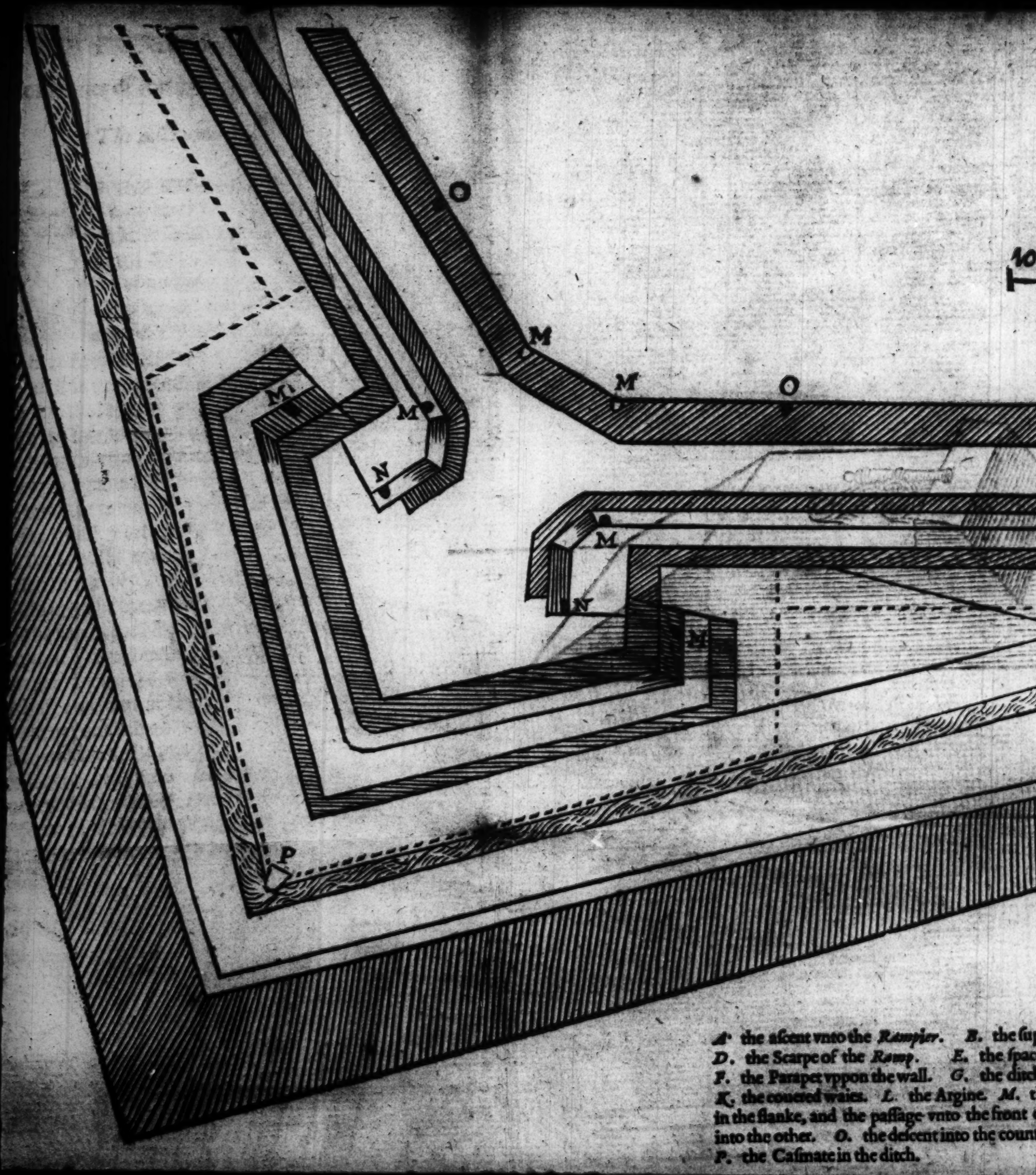
Hauing rayſed the wall vntill the firſt place in the flanke, coꝛdone, oꝛ full heigth (and filled it with good earth well beaten and rammed) which heigth may be fiue oꝛ ſixe foote aboue the argine, and tenne oꝛ eleuen foote aboue the conterſcarpe oꝛ leuell it ſtandeth vpon, make the Foꝛt defenceable, rayſing a parapet oꝛ bammure vppon the front of the bulwarke and curtine, of good earth of tenne foote thicke, the inſide foure foote and a halfe, oꝛ fiue foote high, and the outſide thꝛée foote and a halfe, oꝛ moꝛe, becauſe it will ſettle, which outſide and inſide muſt be of turfe, and the ſuperficies muſt be beaten and layde hanging towarde the ditch in ſuch ſoꝛt, that the couerd way and counterſcarp may be open vnto the defenders from the inner edge of the parapet: but the parapet in the flanke would be 25. oꝛ 30. foote thicke, & that vpon the cuillon 20. foot at the leaſt: the reaſon thereof is héereafter ſufficiently ſhewed. Afterward dꝛaw a lyne 50. foote equidiſtant vnto the parapet in the flanke foꝛ the requople of the artillery, and another lyne 15. foot equidiſtant vnto the parapet vpon the curtine, foꝛ the defendoꝛs to paſſe betwéen the parapet and the rampier that is intended to be rayſed vpon the curtine at this ſaid line, and from a pꝛicke 20. foote diſtant from the parapet vpon the ſhoulder of the bulwarke, extend a line towarde the exteriour angle of the ſame, but not equidiſtant vnto the parapet, but in ſuch ſoꝛt, that the rampier which ſhall be raiſed at that line, may be defended from the artillery in the ſecond place of the flanke, as the front of the bulwarke was from the firſt. And vppon this flowꝛe alſo, oꝛ two oꝛ thꝛée foote vnder it, (to the intent they may lie the lower) would the flowꝛes and wayes foꝛ the paſſage of the artillerie into the caſemate and front of the bulwarke, and likewiſe that out of the one flanke into the other, be laide, which muſt be ſo bꝛoade, that any péere may paſſe with eaſe: but that foꝛ the paſſage from flanke to flanke may be bꝛoader then the other, and layde out in foꝛme like the front of a bulwarke: as in the Figure following is ſéene: the reaſon thereof is héereafter ſufficiently ſhewed.


100. foot

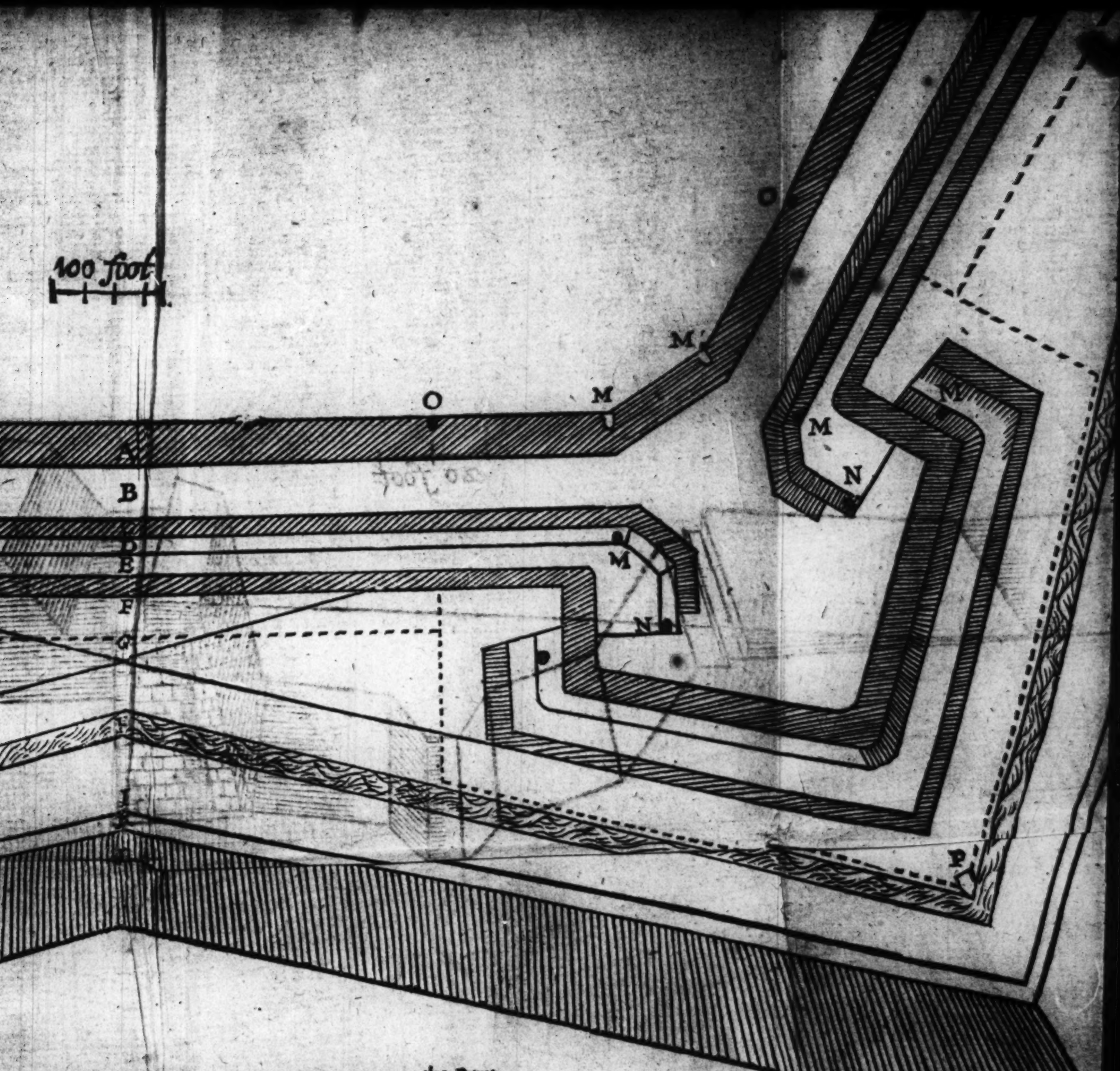
The parapet being raiſed vpon the Bulwarke and Curtin, to proceede to the full finiſhing of the Fort in this worke pretended, at the lines ſignified by the prickes in the figure before going, raiſe the rampart vnto the full height, which were neceſſarie to be 12. foote at the leaſt higher then the wall, or firſt place for the Artillerie, and raiſe the wall in the inſide of the Cullion, with the Eſperons or Counterforts in it, (to beare the earth in the angle next the flancke) ſo high as it is intended the rampier ſhall be, but plumbe as the vnderworke is, but outward toward the Cullion let the ſame wall ſcarpe endwaies as the rampier doth: and raiſe alſo the walles of the waies for the paſſage of the Artillerie into the flankes, and front of the Bulwarkes, which muſt be vaulted ouer, but muſt be layd as lowe as they may that they be not ſeene vnto the enemie. And as for the paſſage from one flanke vnto another, that may bee left vnvaulted, and the walles of it raiſed as high as the ſuperficies of the rampier, and couered ouer with timber. At which may a retrenchment bée made when need requireth, and the ſame well flanked, as by the manner of the lining of it in the figure before going is to bee ſeene. The rampier muſt be raiſed ſcarping, battering, or comming in, for euery one foot of height one foot of ſcarpe: but that part toward the Cullion muſt be raiſed flatter then the reſt, and that within the flanke or caſemate need not to bee raiſed altogether ſo flat, and it muſt be of earth only without any faggot, that it may the better cloſe and ſettle together. And the reaſon why this rampier is ſo high and farre diſtant from the edge of the wall, is, that the whole fortreſſe might from euery part of it the better offend an enemie, and as a caualier commaund, and domayne ouer any thing an enemie might put in practiſe before it. And that alſo the wall being battered, this yet might ſtand defenceable for a retreate. (but note, that to eaſe the charge that the carrying of this great maſſe of earth would coſt, the rampier vpon the Curtins need not to be raiſed ſo high as that vpon the Bulwarkes: neither if the Fort do ſtand well watered need the face of the Curtin to be raiſed with brick or ſtone higher then three or foure foote aboue the water: but from thence vp-

ward ẏ rampier must be raised to his full heighth. These things may be done for sparing of charges, but perfection were better) Upon which rampier must a parapet bée rayled of 20. foot thicke vpon the Bulwarke, and ten foote vppon the Curtin: for this order would be obserued in the parapet. Where Artillerie is to be vsed of necessitie in a permanent place, as in a flanke, vpon a caualier, platforme, or Bulwarke; there almost no thicknes of parapet is to be thought sufficient, so that ẏ place will permit it. But vpon a Curtin which is extended wide and broad, and may offend an enemie sometime from one place, & sometime from an other, there needeth no such thicknes. And being enforced at any part to reenforce the parapet, it may there with lesse labour and anoyance be done, then vpon a Bulwarke. The superficies of the rampier must bee so broad, that any peece may be vsed vpon it, and haue scope enough to recoyle. And the ascent vnto it must lye so flat that the defenders may runne vp vpon it with ease, or plucke vp a peece of Artillerie by hand at any place of it, and therefore it must be free of incombraunces. Also the streetes of the Fort must runne all direct from the Bulwarkes vnto the market place, and likewise from the middest of the Curtins. Which market place must bee large 300. foote square, or little lesse. The gate of the Fort must be placed in the middest of the Curtin, that from the Bulwarks on both sides of it, it may be equally defended, and must be set so lowe, that the defenders may go out and in to the couered waies, to defend the argin, or sallie out, as little seene as may be. But the chiefest defence of the argin must be through the priuie doores in the Cullion, passing the secrete ditch with a portable bridge, which may bee lightly layed and taken away, ascending the Counterscarpe: which Counterscarpe may be left somewhat flat, and pared steeper as need requireth. The casemate in the ditch (for not onely the first place in the flanke is called casemate, but also any other edifice that may be made in the ditch to defend the ditch by) must be placed opposite to the exteriour angle of the Bulwarke, betwixt it and the secrete ditch, and must bee made full of holes to vse Harquebuze and Musket out at. And the walles of it must be so thinne, that being

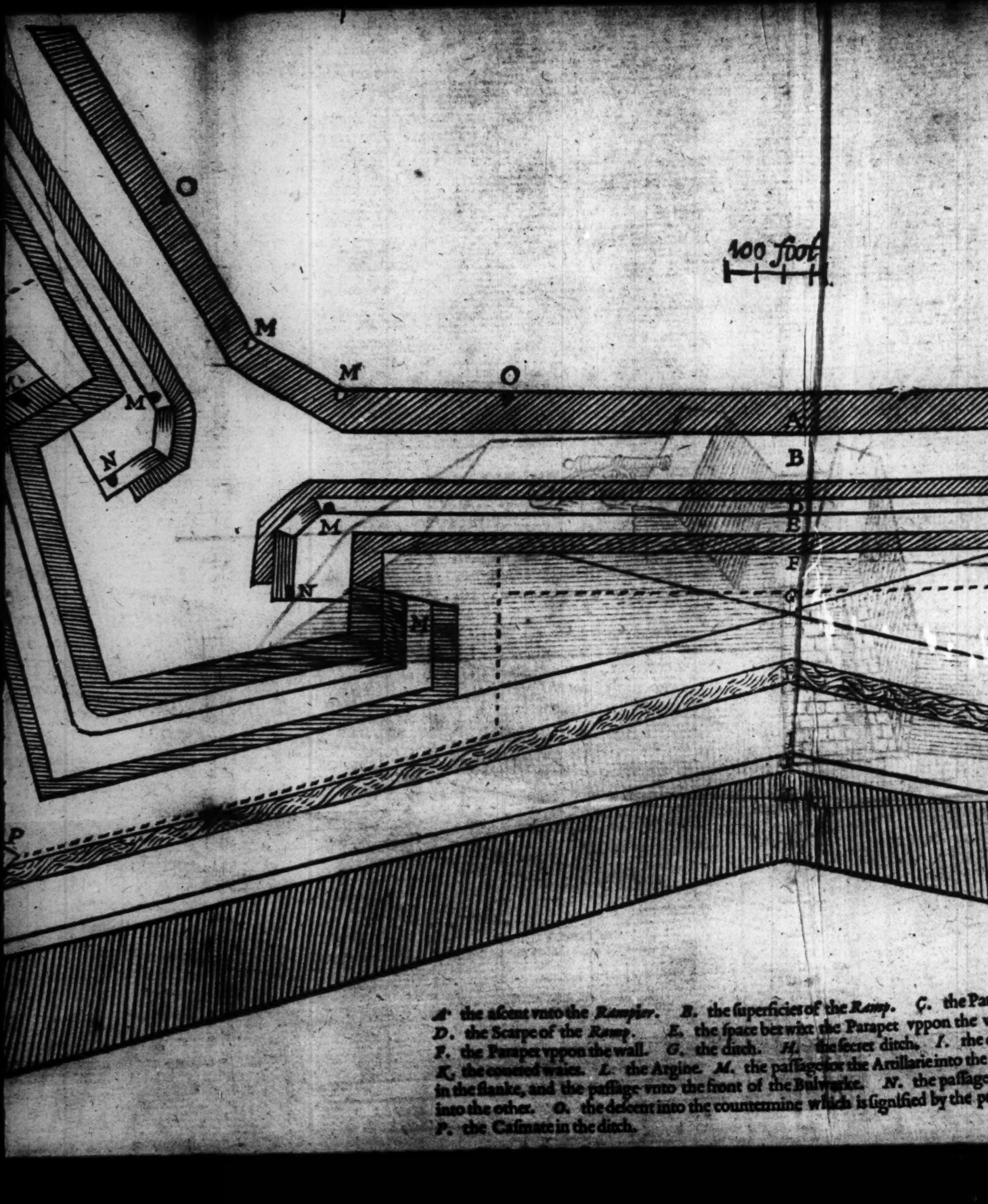
being ruined, the ruine may make no great bodie in the ditch: and the way to man it, must be vnder ground, through the countermine, or by some other vault made for the purpose. The couered way round about the Fort must be ten foote broad, and the argin or banke so high that a man be not seene behind it: which may be sixe or seauen foote, and against it there must be steppes made for the defenders to stand vpon to vse their armes ouer it; and to mount vpon it, when it shall be needfull. The superficies of the argin must be layd scarping, but in such sort that it may be scoured from the Fort, as in the figure following is seene. Here note, that as in a drie ground where an enemie may trench & couer himself from the fort, an argin & couered way, were thought necessarie, to giue him the more impeachment to approach the Counterscarpe: so in a lowe waterie ground where an enemie cannot couer himselfe, it were not good to make any argin at all: least you giue him the meane to do the mischiefe which, you would hinder him from doing.



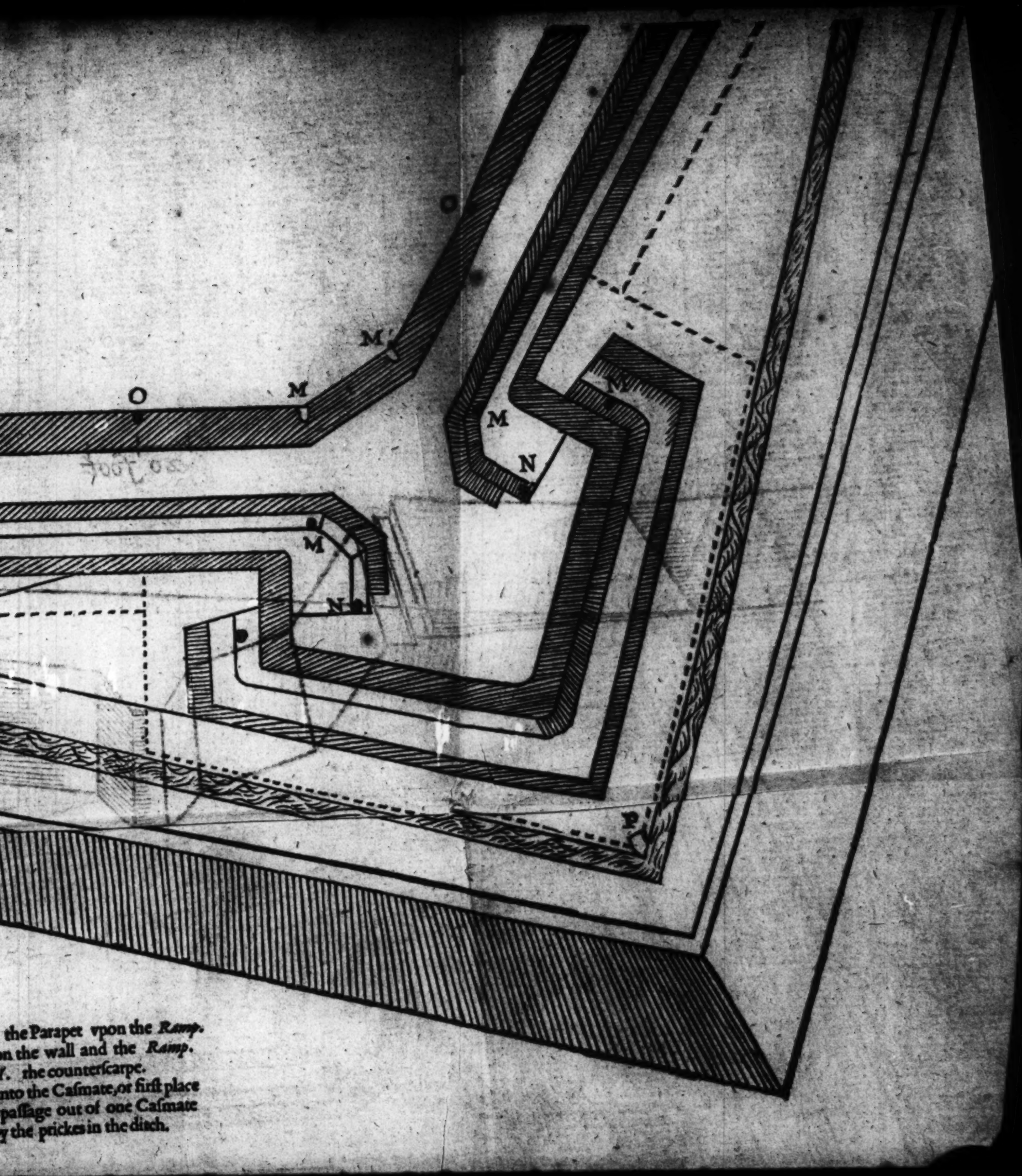
A. the aſcent vnto the *Rampier*. *B.* the ſu
D. the Scarpe of the *Ramp*. *E.* the ſpac
F. the Parapet vppon the wall. *G.* the ditc
K. the couered waies. *L.* the Argine. *M.* t
in the flanke, and the paſſage vnto the front
into the other. *O.* the deſcent into the count
P. the Caſmate in the ditch.



B. the superficies of the *Ramp*. *C.* the Parapet vpon the *Ramp*.
E. the space betwixt the Parapet vppon the wall and the *Ramp*.
G. the ditch. *H.* the secret ditch. *I.* the counterscarpe.
gine. *M.* the passage for the Artillarie into the Casmate, or first place
the front of the Bulwarke. *N.* the passage out of one Casmate
to the countermine which is signified by the prickes in the ditch.



A. the aſcent vnto the *Rampier*. *B.* the ſuperficies of the *Ramp*. *C.* the Pa
D. the Scarpe of the *Ramp*. *E.* the ſpace betwixt the Parapet vppon the w
F. the Parapet vppon the wall. *G.* the ditch. *H.* the ſecret ditch. *I.* the
K. the couered waies. *L.* the Argine. *M.* the paſſage for the Artillarie into the
in the flanke, and the paſſage vnto the front of the Bulwarke. *N.* the paſſage
into the other. *O.* the deſcent into the countermine which is ſignified by the p
P. the Caſmate in the ditch.

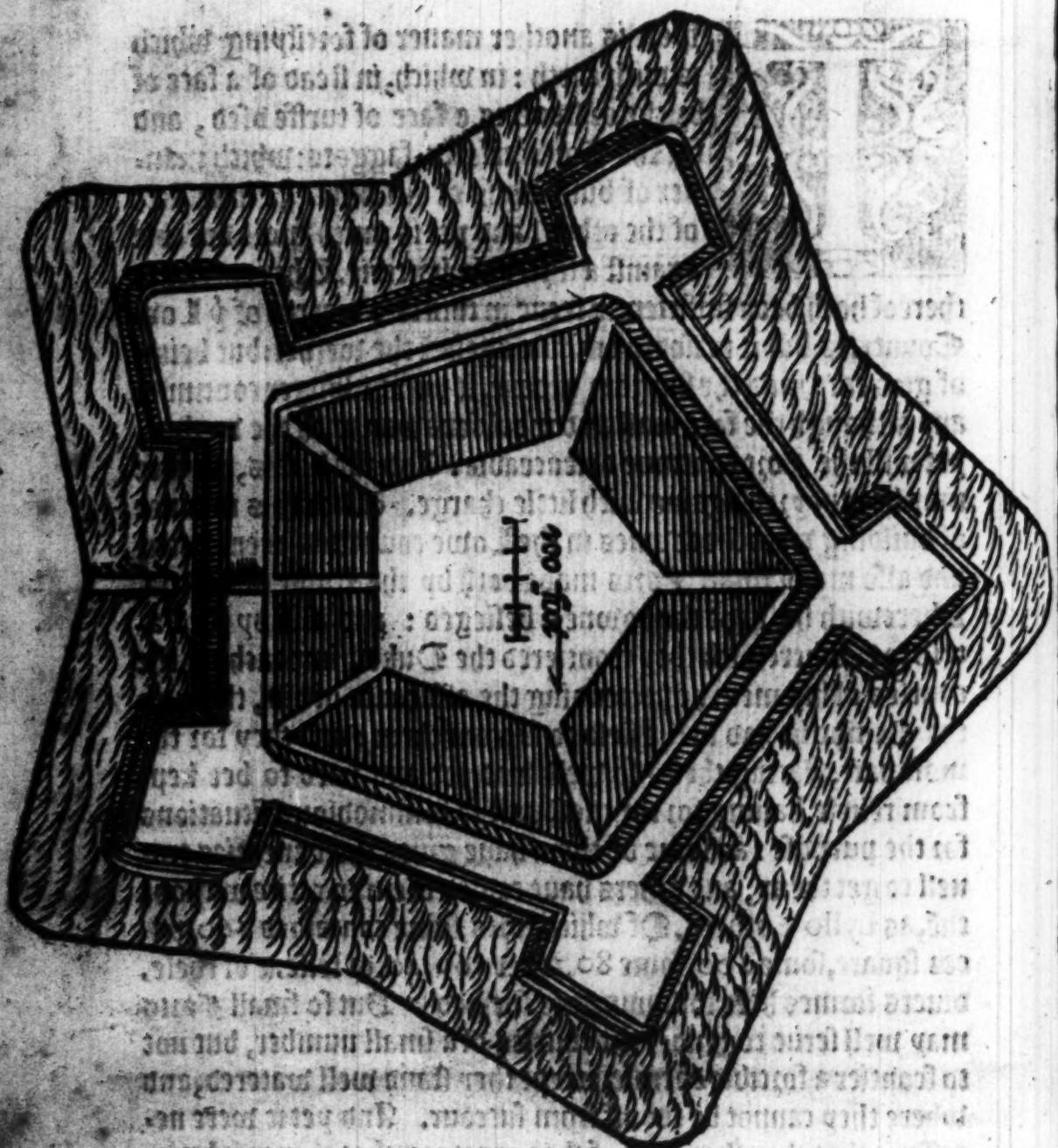


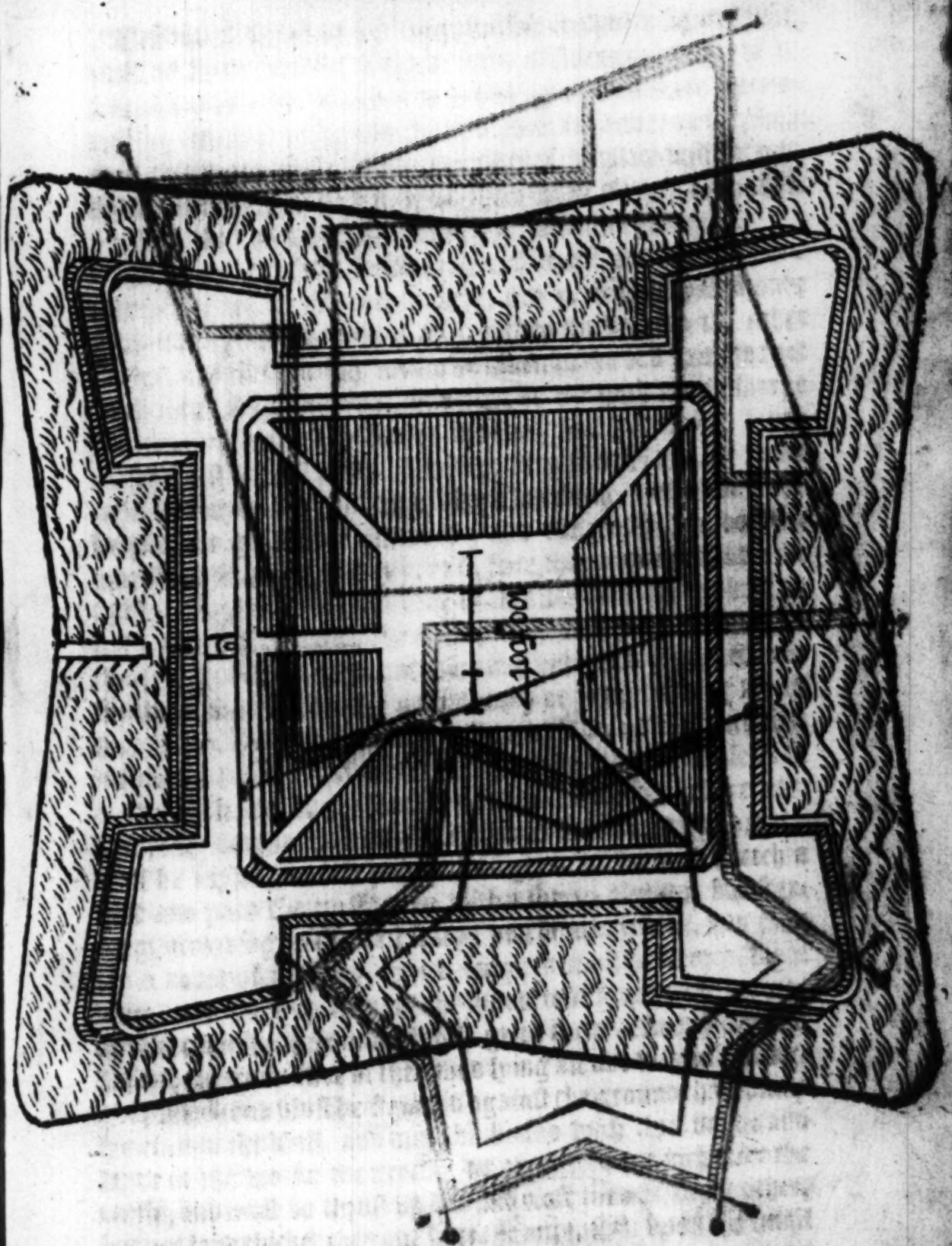
the Parapet vpon the *Ramp*.
n the wall and the *Ramp*.
. the counterſcarpe.
nto the Caſmate, or firſt place
paſſage out of one Caſmate
y the prickes in the ditch.

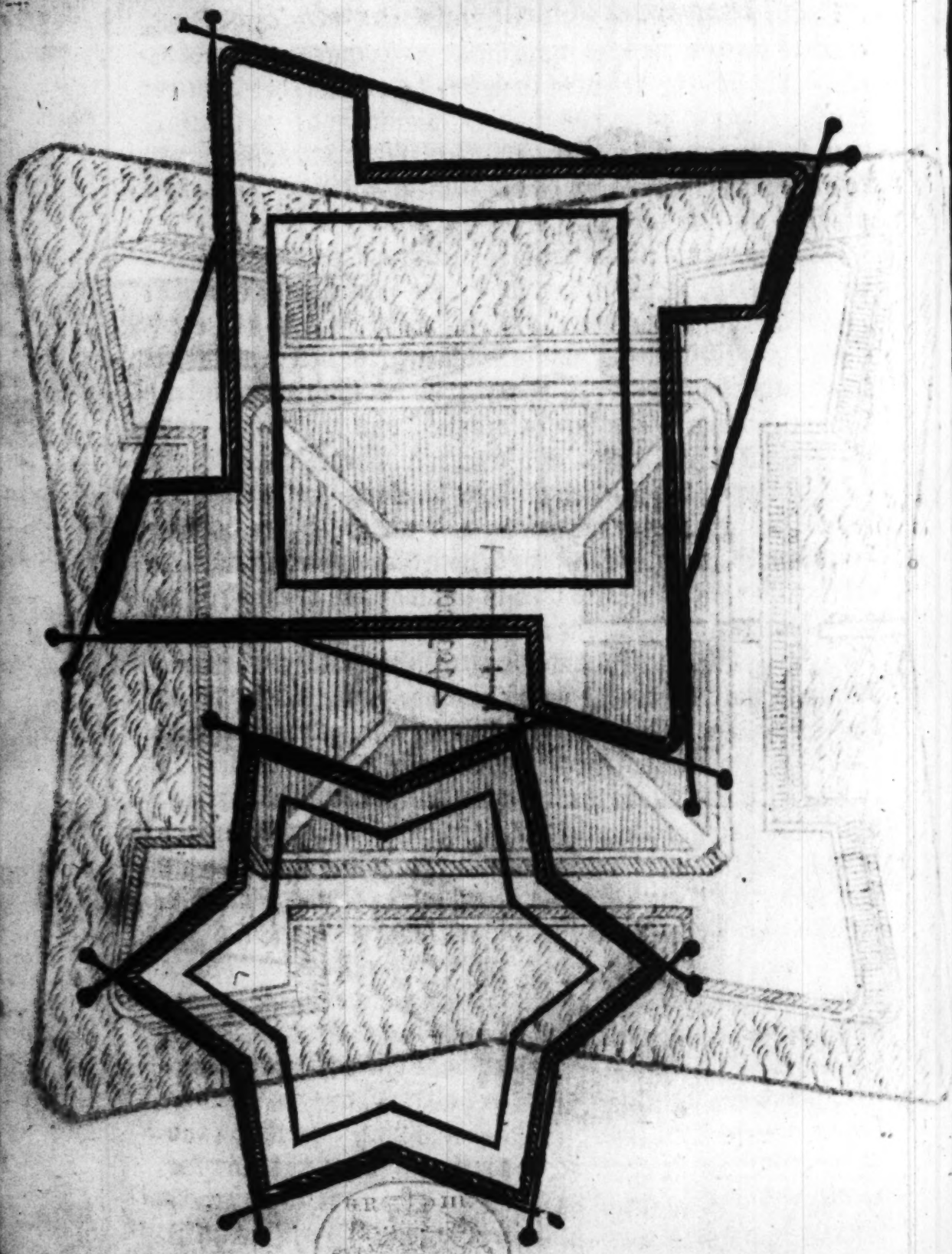
The manner of fortifying with earth.

The 4. Chapter.

There is another maner of fortifying which is with earth: in which, in stead of a face of bricke or stone, is a face of turffe vsed, and for the Counterforts, faggots: which manner of building is of little charge in respect of the other, and yet is much more durable against a forceable batterie. The experience thereof hath been sufficiently seene in this late warres of ỹ Low Countries; but it is not so durable against the wether: but being of good earth and the faggots greene, it wil the longer continue: and although the face wall and moulder away with the wether, yet will the Fort continue defenceable. And the best is, the face may be repayred againe with little charge. With this manner of building were the townes in the Lowe countries reenforced, and also many small Forts made both by the Duke of Parma, wherewith he kept the townes besieged: and also by the Patriotes, when they frontiered the Duke, impeaching the courses of his men, pretending the assurance of his, through the Campe he had in the field to succour them: and they for the most part, placing theirs so well watered and hard to bee kept from relefe, hauing for the most part so commodious situations for the purpose: as some of them haue giuen their enemies trauell to get them, and others haue caused them to retire without thē, as Lyllo & others. Of which forts, some contained 160. paces square, some 100. some 80. others 60. 40. or lesse. & of these, diuers formes here following are shewed. But so small Forts may well serue to hinder the courses of a small number, but not to frontier a forcible enemie, except they stand well watered, and where they cannot be cut off from succour. And yet it were necessarie that they should be of that greatnes, that they might receiue and lodge foure or fiue hundred men at the least, leauing the rampiers, streetes and place of assemblie, or market place free.




100
200
400



Beſides theſe, there are diuers other irregular formes vſed, moſt of them carying a more ſhewe of ſtrangenes then of defence: but ſith the defences in ſo ſmall Forts as theſe proceede chiefly, either of bulwarks, halfe bulwarks, and tenailes, theſe may ſuffice, admoniſhing the Fortifier, if the place will permit, to vſe as well in the delyning of theſe ſmall Forts, as in thoſe greater, the conſiderations before in them alleaged.

The manner of the worke is this: the turffe muſt be cut like a wedge, of 12. or 14. inches long, and 5. or 6. inches broade equidiſtant, the one ende 4. or 5. inches thicke, and the other ſharpe, and theſe turffes would be taken in the beſt ground that lyeth neere about the Fort, and muſt be cut with a long ſharpe Spade, of fiue or ſixe inches broade, and 14. inches long, which muſt be well ſteeled, and kept very ſharpe: and the turffe muſt be caryed and handled without breaking, and layde in the worke, the great ende outward, and the graſſy ſide downeward, and ſcarping, one in 5. or 6. foote, the rampire behinde the turffe riſing with the earth that is throwne out of the ditch, as faſt as the face of the worke riſeth. (And when the face is raiſed the heigth of fiue turffes, and the earth behinde it layd euen, and ſpread almoſt as broade as the rampier is pretended (which may be 20. 30. or 40. foote, and more or leſſe, as the earth that may be throwne out of the ditch will make it) or at the leaſt ſo broade as it is thought that the wood will lye: for to ſay truth, to throwe downe the earth, or to ſpread it ſo broade before the wall be rayſed, were a point of no great wiſedome) ſtretch a lyne and pare the turffe euen with a ſharpe Spade, but ſcarping, according to the firſt ſcarpe you layde them at, and then lay a rowe of faggots, which faggots muſt be 8. or 9. foote long, and more or leſſe as the wood will giue them, but not thicker then that you may almoſt gripe them betwixt your two hands, the great ende of the wood lying all one way in the faggot, which end muſt be ſtamped againſt the ground that it may lye euen in the wall, and muſt be bound with three bonds and layde in the worke the great ends outward, one inch ouer the turffe, and muſt be thruſt vp faſt and cloſe the one to the other, but not layd thicker then one fagot at once. And vpon the ſmall

ends of thole firſt layd faggots, muſt other faggots be layde, whoſe ſmall ends muſt ouerlappe the ſmall ends of the ſaid firſt faggots, ſome three foote and a halfe or thereabouts. And vpon the great ends of theſe ſecond faggots, muſt a third faggot be layde, whoſe ſmall ends muſt likewiſe ouerlappe the great ends of the ſaid ſecond faggots, as the ſmall ende of the ſecond did the ſmall ends of the firſt, (and where wood is plentie, hauing haſte to rayſe the worke, lay a fourth faggot in like manner,) which being done, rayſe againe the face of the worke fiue turffes higher, paring them by a lyne as is aforeſayde, and rayſing the earth behinde them as before, and then lay another rowe of faggots, and thus continue the worke, vntill it riſeth ſome twelue foote, aboue the foote it ſtandeth vppon; which foote muſt be left fiue foote broade, vntill the Fort be full ended to receiue the earth which ſhall be throwne out of the bottome of the ditch, which from thence muſt be throwne into the Fort, and this foote muſt be afterward cut narrower flat off, but not ſo narrowe that it might put the rampire that ſtandeth vppon it in danger of falling. Which done, raiſe a parapet of ſome fiue or ſixe foote broade, more or leſſe, according to the greatneſſe of the Fort, and largeneſſe of the rampier, and make the ditch if it be where water aboundeth the broader, but ſtanding dry, the narrower and deeper. A great care muſt be had in making of the ditch, of the goodneſſe of the ground, for feare of laying the worke vnder feete, to auoide which inconuenience, the beſt way is to leaue the wall a verie good foote, and not to ſinke the ditch too deepe on that ſide next it, but rather to make a ſecret ditch in the midſt, or to make that ſide next the counterſcarpe very deepe, leauing the other ſide the ſhowler. Where wood is ſcarce, there vſe none but in the bulwarke only, and there as little as you may, but only to ſtay the faces of the bulwarke; and raiſe the face of the curtine with turffes only, giuing them ſomewhat the more ſcarpe, or for a neede vſe no wood at all, and where turffe would fall out ſcant, ſo that the ditch would be well watered, vſe none but in the bulwarks, and rayſe the courtine with earth onely, making euery way a iuſtus of neceſſitie.

The

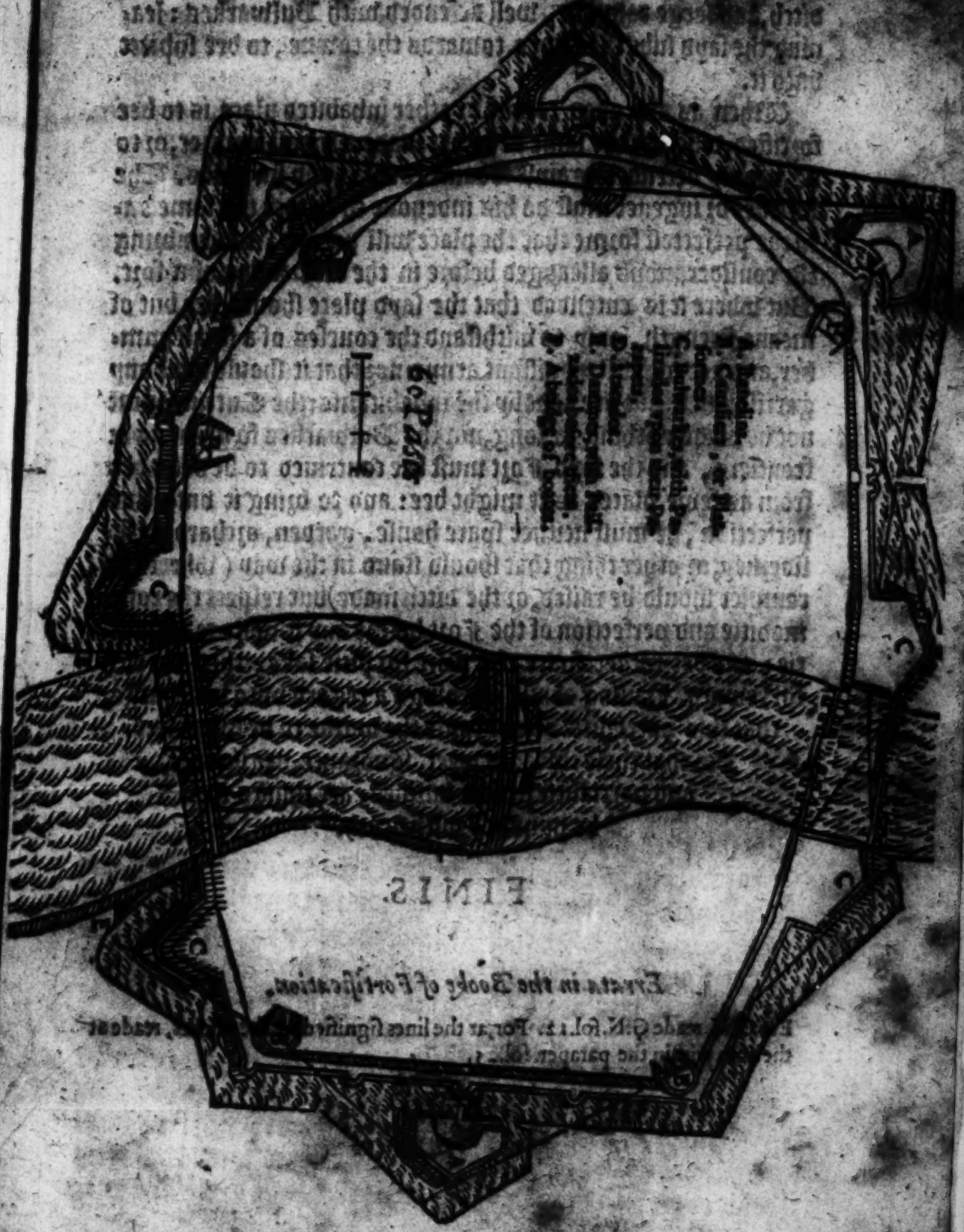
The manner of fortifying of old walled Townes.

The 5. Chapter.

For that the Townes enclosed with weake walles of stone, and defended with small, square, or round towres, are insufficient to abide the mallice and offence that an enemy at this day may put in practise, the Cannon being an engine of much more force then any before it inuented. To resist whose violence, other meane cannot be giuen, then to rampier those walles within, and make greater and royaller defences without; which defences, where the ditches are narrowe and showle, the wall running any thing straight, or not making so great an arke, but that from any reasonable large flanke the same may be scoured, would be set ioint to the wall as bulwarks, and those Towres sayned that might impeach the artillerie in their flanks to scoure the wall: but where the ditches are deepe and broade, or the wall too much circulare, there the defences would be placed without the counterscarpe, both for the better flanking of the wall, and to auoide the great charge, labour, and time, that the filling of the ditch, and farre fetting of the earth to raise the worke would require, and being so placed, they are tearmed to be rauelins of the Italyans & Frenchmen, and of vs they haue bén tearmed spurres. Of Bulwarks there is sufficiently before spoken, but yet heere note, that it shall not be necessarie to make these Bulwarks in Townes, so great as those in royall frontires, committing the charge of them vnto Townesmen, except the same be well peopled Cities; neyther were it good to bestowe too great cost vppon the fortifying of any euill situated place, for suche thynges are easye for an enemy to gette, and hard afterwarde to bée gotten out of his hands, but for the helping

of a raueling, if the same be to be placed against the side of a towne, take this course being vpon the ground where the raueline should stand, goe perpendicularly from the wall and counterscarpe some 140. or 160. foote, or more or lesse as you will make it great, hauing respect vnto the necessitie, and vnto the valour, and number of the defenders that be vpon the place, or may be had vpon a suddaine, and set downe a stake for the exteriour angle or point of the raueline: then turning toward the wall, behold from what place the same raueline may best be defended, which must be by cauelliers or platformes rayſed within the wall, except the wall and rampier bee of sufficient breadth to place artillerie vppon, which must not stand farther distant from the exteriour angle or point of the rauelin then 180. paces at the vttermost, & from those platformes or caualiers vnto the same exteriour angle, drawe two right lines for the fronts of the raueline, which fronts may not be continued vppon those lynes vnto the counterscarpe (because the extreames of the next the counterscarpe would fall out too weake & indefencible) but must be cut off perpendicular from the counterscarpe or wall at some reasonable breadth, leauing both ends of the rauelin as the flanks or cullions of a bulwarke, and it must lye wholy open toward the towne, that the towne may command, and domaine ouer it, and that an enemy entred, may haue no succour in it, to assure himselfe from the artillerie and harquebuserie of the towne. And it must be manned by a bridge which must be layd as low, and couered as possibly it may. But if the ditch be dry, then make the way into it through a vault vnder the ground, or through the bottome of the ditch, and shut in both the sides or flanks of the raueline vnto the wall with a strong palizado to assure it from surprice. And when a raueline is to be placed vppon an angle, then proceede as in the deyning of a bulwarke, but neuer place a rauelin vppon a sharpe or right angle, because it would fall out too sharpe, but within the right or sharpe angle place a platforme which may defende the rauelins vppon the lines on either side of it: and note also that you may not vppon any other angle take the flanke of a rauelin so royall and large, as you would the flanke and shoulder of a bulwarke, be-

cause



ditch, and large rampier, well defended with Bulwarkes: leauing the sayd suburbes open towards the towne, to bee subiect vnto it.

When as any open towne or other inhabited place is to bee fortified, whether the same be to bee made a royall frontier, or to be meanly defended against sodaine courses and surprises. The fortifier or ingener must do his indeuour to reduce the same vnto the perfectest forme that the place will permit, remembring the considerations alleadged before in the delineation of a fort. But where it is entended that the sayd place should bee but of meane strength, only to withstand the courses of a small number, and not to resist a puissant armie: nor that it should haue any garrison in it, but bee kept by the inhabitants: the Curtins must not be made nothing so long, nor the Bulwarkes so great as in frontiers, and the sayd Fort must bee contriued to be defended from as fewe places as it might bee: and to bring it vnto this perfection, he must neither spare house, garden, orchard, backside, key, or other thing that should stand in the way (where the rampier should be raised, or the ditch made) but respect the commoditie and perfection of the Fort before any priuate commoditie: and not rather spare the pure for pitie sake, then the rich for reward. Hauing about all things a regard vnto his charge, that this partialitie do not cause the worke to be imperfect.

For that these three: to weet, ignorance, negligence, partialitie in this busines, are things to be punished with death.

FINIS.

Errata in the Booke of Fortification.

For [illegible] made G.N. fol. 22. For, at the knee signified by the prickes, made at the knee within the pamper. fol. 25.